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## Re-evaluation of the House Finch subspecies *Carpodacus mexicanus roseipectus* from Oaxaca, Mexico

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In his *Catalogue of the birds in the British Museum*, Sharpe (1888) described *Carpodacus roseipectus* based on two adult males from "Oaxaca, W. Mexico (A. Fenochoio)" and one adult female from "Oaxaca, Nov. 1860 (A. Sallé)". Ridgway (1901) later reduced *roseipectus* to a subspecies of *Carpodacus mexicanus* (Müller). Moore (1939), in his detailed taxonomic revision, and Miller *et al.* (1957), in the most recent treatment of Mexican subspecies, also accepted *roseipectus*, the latter presumably on the advice of co-author Moore. Neither Ridgway (1901) nor Moore (1939), however, personally examined specimens of true *roseipectus* and, as a result, the subspecies has never been properly characterized.

In the mid 1960s, when T. R. Howell, R. A. Paynter, and A. L. Rand (Paynter 1968) were revising the Carduelinae for "Peters' Checklist", Howell (*in litt.*) asked me if I thought *roseipectus* was a valid race; I thought not, having seen specimens of both presumed *roseipectus* and typical *C. m. mexicanus* from the Oaxaca Valley. Howell (in Paynter 1968) therefore subsumed *roseipectus* in *C. m. mexicanus*.

Later, however, I learned that the specimens of nominate *mexicanus* supposedly from the Oaxaca Valley possessed untrustworthy data and almost certainly came from elsewhere. I therefore suggested (Binford 1989) that *roseipectus* should be re-evaluated and properly characterized in light of this knowledge. In this paper, I do so.

### Data on Mario del Toro Avilés specimens

All specimens of *C. m. mexicanus* supposedly from the Oaxaca Valley were collected by Mario del Toro Avilés and labelled "Mitla" (San Pablo Villa de Mitla of Binford 1989), a village 48 km east-southeast of Oaxaca City.

M. del Toro Avilés was a professional collector but was poorly versed in proper labelling techniques. In some cases his localities are clearly erroneous, suggesting

that none can be trusted. A full discussion of this subject may be found in Binford (1989: 60–62). This independent conclusion is supported by Marshall (1964: 353), Crossin and Ely (1973), Dickerman (1974: 9), K. C. Parkes (*pers. comm.*) and A. R. Phillips (*in litt.*).

Specimens of other species labelled “Mitla” by del Toro Avilés have been shown to be from elsewhere. According to the collector himself, his “Mitla” specimens of the Canyon Towhee *Pipilo fuscus* actually came from Tepeaca, a town at 2,257 m in southern Puebla (Marshall 1964: 353); this species is otherwise unknown from the Oaxaca Valley. Further, Dickerman (1974: 9–10) showed that 13 intergrades between the Red-winged Blackbird races *Agelaius phoeniceus gubernator* and *A. p. nelsoni* were probably taken in Puebla. That the questionable House Finch specimens were collected supposedly in 1942 and 1943 (see dates below), the same months and years as the towhees (January 1942 and January 1943) and blackbirds (June 1942), suggests that they also came from Puebla.

One might argue that the dubious Oaxaca Valley House Finches represent migrants from the range of *mexicanus* to the north, but migration is unknown in southern populations of the species. I know of no environmental conditions that would induce migration, and no one else has taken a bird with such a phenotype in the Oaxaca Valley. For further discussion of this subject, see *Provenance of M. del Toro Avilés specimens* below.

I conclude that the del Toro Avilés specimens were not collected in the Oaxaca Valley but probably in Puebla and should be disregarded with respect to the validity of *roseipectus*.

## Previous descriptions

The subspecies *roseipectus* has never been properly characterized. In his original diagnosis, Sharp (1888) described each part of the plumage of the adult male but, following the style of the day, failed to specify the characters separating it from true *C. m. mexicanus* (or other forms recognized today) or define his colour terms. Also, his series of “*Carpodacus mexicanus*” might have contained a mixture of subspecies. His only useful characters involved the extent of reddish on the underparts, as follows: “fore neck and breast ashy brown, all washed with pale rose-colour . . .; under tail-coverts whity brown, washed with rosy. . . .” Quite correctly, he considered the female indistinguishable from that of “*C. mexicanus*” [= *C. m. mexicanus*].

Ridgway (1901) treated *roseipectus* as a distinct race of *C. mexicanus* but questioned its validity—for good reason. I have examined the only two specimens (United States National Museum Nos. 143693 and 143694) available to Ridgway, both from Huajuapán de León in northern Oaxaca, and find that the characters attributed to them, and hence to *roseipectus*, are mostly erroneous. Compared to nominate *mexicanus*, their bills are not “decidedly larger” but quite average (exposed culmens 10.5 and 10.7, respectively; see Table 1), and the brown and whitish parts of the plumage are not darker but identical. The red of the head and throat of 143693

is, as noted by Ridgway, darker and more purplish than in most *mexicanus*, but this does not accord with *roseipectus* either; 143694 is scarlet like *mexicanus*. Thus I agree with Moore (1939) that they are in most respects typical *uexicanus*.

Moore (1939) also saw no specimens of *roseipectus*, basing his acceptance of the race on correspondence with J. van Rossem, who in 1938 examined four males (including the type, No. 85, 12, 14, 1146) and two females in the British Museum. Concerning the type, van Rossem noted an "orange-red flush over the whole of the under parts—very faint on abdomen and flanks—strongest on chest. Otherwise, like *mexicanus*, particularly in the sharply defined throat patch." The other males were similar. Judging from van Rossem's description, the British Museum males are extreme examples of *roseipectus* in the extent of reddish.

My analysis of the plumage of adult males more clearly defines the shade and distribution of reddish and brings to light several additional characters.

## Diagnosis

Here I describe the characters that separate adult male *roseipectus* from the only contiguous subspecies, *mexicanus*, by comparing Oaxaca Valley *roseipectus* to *C. m. mexicanus* from Morelos and Distrito Federal. Two birds from Hidalgo and most from Puebla (but see *Intergradation*) also fit *mexicanus*. Later I will briefly discuss the allopatric *C. m. griscomi*. Other allopatric races farther north share some of the characters here assigned to *roseipectus*, including extensive reddish on the underparts, but those comparisons must await the thorough taxonomic revision advocated by Hill (1993a). Because House Finch plumage varies considerably through wear and fading, I used only fresh-plumaged skins taken from October to early March. Capitalized colour terms follow Ridgway (1912). I found no plumage differences between six adult females of *roseipectus* and a large series of *mexicanus*.

*Upperparts*: I found no difference in the colour or pattern of the upperparts. The colour and extent of red on the forehead and superciliaries, unlike the throat region, appear the same. Note that unlike races farther north, this red is sharply defined from the brownish of the crown and face. The darkness of the grey-brown back, obscure back streaks, scapulars, wings, and tail is the same when birds taken at the same time of year are compared. The amount and hue of red on the rump vary so much that I considered detailed comparison impossible; the two races are very similar if not identical.

*Throat region*: In both races, the red of the chin, throat, and malar region form a patch sharply defined from the face and breast, even though a paler reddish wash extends onto the breast of *roseipectus*. In both races, throat colour varies somewhat, but in series is Scarlet-Red in *roseipectus* and Scarlet (*i.e.*, more orangish) in *mexicanus*. In most specimens of *roseipectus* the colour also tends to be brighter, glossier, and denser. Dietary access to carotenoid pigments is well known to affect the colour but not the extent of reddish/yellowish in males (Michener & Michener 1931; Hill 1993a). When *C. mexicanus* males were fed high-carotenoid and low-

carotenoid diets, they grew bright red and drab yellow throat feathers, respectively, but the extent of carotenoid-pigmented area on the ventral surface did not change with diet (Hill 1993b). Moreover, when a *C. m. griscomi* female was paired with a *C. m. frontalis* (Michigan) male, the male offspring had the extent of ventral pigmentation intermediate between the two parental types (Hill 1993b). Thus extent of pigmentation is not dependent on diet. I assume this is the case with *roseipectus* and *mexicanus*, although these races have not been tested. I wonder, however, if diet affects brightness, glossiness and density.

*Breast:* Of 10 fresh (February-March) specimens of *roseipectus*, nine have a strong wash of Rose Doree variable distances onto the breast, and four as far as the mid abdomen. One has only a weak wash of the same colour on the upper breast. *C. m. mexicanus* normally has no reddish below the throat; according to Ridgway (1901), rarely some slight "bleeding" occurs onto the extreme upper breast, but whether this is within normal variation or the result of intergradation is unknown.

*Abdominal ground colour:* The ground colour of the abdomen of *roseipectus*, where not washed with Rose Doree, is noticeably paler, more whitish, varying from very Pale Pinkish Buff to Pale Pinkish Buff. The same area in *mexicanus* averages more buffy, varying from Pale Pinkish Buff to Light Pinkish Cinnamon. In a series of fresh specimens, this difference is clearly appreciable. It is less useful in worn birds because the darker colour of *mexicanus* fades. It did not have enough specimens to test whether the races could be separated if specimens were compared date for date. Because the dark abdominal streaks are narrower in *roseipectus*, the pale interspaces are slightly wider, adding to their conspicuousness.

*Abdominal streaks:* The dark streaks on the abdomen of *roseipectus* are noticeably narrower and slightly sharper-edged (less blurred) than in *mexicanus*. The colour is the same. Next to the extent of reddish, the narrower and sharper streaks, coupled with the paler, more extensive ground colour, is the best way to distinguish *roseipectus*. These characters have not been described previously.

*Flanks:* I see no difference in the width and colour of the dark flank streaks, which are so diffuse as to make comparison difficult. The ground colour does differ on average, Pale Pinkish Cinnamon in *roseipectus* and Light Pinkish Cinnamon in *mexicanus*. However, the colour is very difficult to assess because of the differing makes of skins, in which the flank feathers range from obvious to obscure. Also, fading probably strongly affects this area. Thus I consider flank colour only a minor character.

*Undertail coverts:* Continuing the paler trend, the ground colour of the undertail coverts of *roseipectus* varies from a colour between Pale Pinkish Cinnamon and Light Pinkish Cinnamon to Light Pinkish Cinnamon, whereas *mexicanus* averages between Light Pinkish Cinnamon and Pinkish Cinnamon. Possibly, this area may not fade as much as the more exposed flanks, but this is also a character that is difficult to assess. The important characteristic of the undertail coverts is not, however, the

ground colour but the presence of pale reddish. Nine of 18 *roseipectns* (including worn specimens) have at least one feather with a wash of Rose Doree; *C. m. mexicanus* seems never to have any reddish there. Some care is needed to avoid confusing a reddish undertail covert with a displaced rump feather in study skins.

*Size* (Table 1): Normality and homogeneity among populations from Oaxaca (*roseipectns*), Morelos (*mexicanus*), and Puebla (*mexicanus*) were examined for wing, tail, and culmen lengths. A Bonferroni multiple comparison test was performed when an ANOVA was significant. A contrast test between Oaxaca vs Morelos and Puebla combined was also performed. All statistical analyses were conducted using SYSTAT 5.03 (Wilkinson 1990).

In wing length, *roseipectus* averages significantly smaller than *mexicanus* from Morelos and Puebla (ANOVA:  $F=12.8$ ,  $df=2$  and  $40$ ,  $P<0.001$ , Bonferroni  $P<0.01$  for both) and from the last two states combined ( $F=46082.4$ ,  $df=1$  and  $40$ ,  $P<0.001$ ). Tail length also is significantly less in *roseipectus* compared to Puebla birds ( $F=3.8$ ,  $df=2$  and  $38$ ,  $P<0.05$ , Bonferroni  $P<0.05$ ) and to the Morelos and Puebla populations combined ( $F=14772.5$ ,  $df=1$  and  $38$ ,  $P<0.001$ ) but not to Morelos birds alone. Although culmen length in *roseipectus* measures slightly longer than in all the three groupings of *mexicanus*, the differences are not statistically significant.

Although, surprisingly, wing and tail seem to average longer in Puebla than in Morelos, thus placing a larger bird between two smaller populations, as noted briefly by Moore (1939), the differences between those two states are not, in my samples, statistically significant.

Larger size in *mexicanus* may be correlated with some unknown selective factor in the environment, possibly greater rainfall, as suggested by Moore (1939).

Of the 44 skins of the two races used for measurements, 15 (34.1%) had at least one of the two measurements (wing or tail length) outside the overlap areas and hence were "identifiable" by that alone. However, this assumes that the ranges of my samples represent the maxima for the populations, which is almost certainly not true. In any event, the 34.1% figure does indicate that measurements are useful for only about one-third of the individuals in these populations and therefore are only a weak indication of subspecific identity.

## Intergradation

*C. m. mexicanus* intergrades with *roseipectns* in northern Oaxaca and Puebla. A series ( $n=15$ ) of males in fresh plumage from Huajuapán de León in northern Oaxaca, 2 taken in November and 13 in January, includes some intergrades. Most are like *mexicanus* in having wide abdominal streaks and ventral red restricted to the chin and throat. In respect to the ground colour of the abdomen, however, about half are closest to *mexicanus* and half to *roseipectns*. One specimen (MLZ 49148) has a suffusion of Rose Doree throughout the breast and on the undertail coverts; its streaking and ground colour are within the variation exhibited by Oaxaca Valley *roseipectus*, to which it would be referred if not for its locality. MLZ 49145 has

TABLE 1

Comparisons of wing (chord), tail, and exposed culmen lengths (range, mean in mm; sample size) in adult male *Carpodacus mexicanus roseipectus* and two populations (Morelos and Puebla) of *C. m. mexicanus*. The differences (d) between means for *roseipectus* and other populations are given; those found to be statistically significant are marked with an asterisk (\*); see text

	Wing	Tail	Culmen
<i>roseipectus</i>	74.2–79.9 (76.8) n=16	58.2–65.0 (61.9) n=17	9.8–11.8 (11.0) n=17
<i>mexicanus</i> Morelos	75.1–81.4 (78.8) n=16; d=+2.0*	61.0–67.4 (63.0) n=13; d=+1.1	10.0–11.4 (10.6) n=16; d=-0.4
<i>mexicanus</i> Puebla	76.2–83.6 (80.2) n=11; d=+3.4*	59.4–69.6 (64.6) n=11; d=+2.7*	10.0–11.1 (10.7) n=11; d=-0.3
<i>mexicanus</i> Morelos+Puebla	75.1–83.6 (79.4) n=27; d=+2.6*	59.4–69.6 (63.7) n=24; d=+1.8*	10.0–11.4 (10.6) n=27; d=-0.4

sparse, faint Rose Doree edgings down to the lower breast. MLZ 49153 has this colour onto the upper breast. As noted previously, both specimens seen by Ridgway (1901; USNM 143693, 143694) are *mexicanus* in plumage.

One male (MLZ 54738) from 5 km northwest of Tamazulapan [del Progreso], a town 26 km southeast of Huajuapán de León, resembles *mexicanus* in all but the abdominal ground colour, which is intermediate. Another intergrade (MLZ 47073), from 5 km northeast of Huauchinango, Puebla, has pale ground colour, streaks of intermediate width, and a pale Rose Doree wash on the upper breast.

The localities Llano Verde and Rancho de las Rosas are at 2,133 m elevation about 40 km northwest of Oaxaca City and thus between there and Huajuapán de León. Two fresh February skins from Llano Verde (MLZ 47740, 47777) have the pale abdominal ground colour of *roseipectus* but the wide abdominal streaks of *mexicanus*; 47740 also has Rose Doree extending onto the mid breast. A worn male (MLZ 37735, July) from Rancho de las Rosas has intermediate streaks and extensive Rose Doree on the breast and some on the undertail coverts; its pale abdominal ground colour fits *roseipectus* but could be the result of fading.

Thus the zone of intergradation appears to stretch from at least Llano Verde and Rancho de las Rosas northwest through Tamazulapan del Progreso and Huajuapán de León to at least 5 km northeast of Huauchinango, Puebla. That putative *roseipectus* from the Oaxaca Valley vary somewhat in the extent of reddish below the throat, here treated tentatively as an individual variation, might suggest that *mexicanus* genes are encroaching on that region (see also *Distribution*).

### Provenance of M. del Toro Avilés specimens

I borrowed from the Moore Laboratory of Zoology 32 adult male specimens of *C. mexicanus* collected by del Toro Avilés purportedly at "Mitla." These were labelled

as having been taken 7–10 January 1942 (3 birds), 1–15 June 1942 (17), 22 December 1942 (1), and 2–20 January 1943 (11). His dates, however, are probably less trustworthy than his localities (Binford 1989). Of these, only 6 (MLZ 32710, 33416, 33418–33421) are clearly *roseipectus*, all labelled from 1 to 7 June 1942. All have extensive Rose Doree on the breast and pale abdominal ground colour, four have Rose Doree on the undertail coverts, and five have narrow dark abdominal streaks (33416 has wider streaks but probably within the range of variation for *roseipectus*).

The other 26 specimens are closest to nominate *mexicanus*, but some exhibit intergrading characters. Like *mexicanus*, all lack reddish below the throat, and 25 have wide abdominal streaks. However, the abdominal ground colour of the 15 fresh December and January birds (June specimens are too faded for comparison), average buffier than *roseipectus* but slightly more whitish than typical *mexicanus* from Morelos. MLZ 34938 has narrow abdominal streaks like *roseipectus*.

I conclude that among the 32 del Toro Avilés specimens I examined, only 6 are *roseipectus*, presumably from the Oaxaca Valley. The apparent intermediacy of the abdominal ground colour in at least 15 specimens and the narrow abdominal streaks of one bird suggest at least some of the 26 came from the zone of intergradation in Puebla. M. del Toro Avilés never collected in northern Oaxaca.

## Synopsis

When M. del Toro Avilés specimens are ignored, only 10 fresh and eight worn birds from the Oaxaca Valley remain. The fresh, and to a lesser extent, the worn specimens, however, are sufficient to reveal that *roseipectus* is a well-marked subspecies restricted to the Oaxaca Valley. Compared with fresh *mexicanus* from outside the region of intergradation, all 10 fresh birds can be identified on the basis of each of the three main characters: reddish extending well onto the breast (to the mid abdomen in four); narrow dark abdominal streaks; and paler and more extensive abdominal ground colour. The first two of these characters serve to identify all worn specimens of *roseipectus*. Reddish in the undertail coverts, when present (nine of the 18 specimens), also denotes *roseipectus*. Average differences in throat, flank, and undertail covert colour and in size may be used to support an identification but are not needed and should not be used to override the primary differences. Compared to *C. m. griscomi* (see below), all *roseipectus* are separable by the presence of reddish on the breast and also by the narrowness of the dark abdominal streaks.

## Distribution

In Oaxaca the House Finch is primarily a bird of arid subtropical scrub, which occupies an elevational and climatological belt from 1,400 to 2,400 m between the warmer (frostless) areas of arid tropical scrub below and the colder (heavy frosts) and moister arid pine-oak forest or edaphically drier steppe above (Binford 1989). Oaxaca House Finches range from 900 to 2,440 m and to an unknown extent occasionally enter

regions dominated by arid pine-oak. The extensive arid subtropical scrub of southern Puebla and northwestern Oaxaca, such as around Huahuapan de León and Tamazulapan del Progreso, extends up along tributaries of the Río Balsas.

Between Huajuapán de León and the Oaxaca Valley is what appears to be a formidable barrier to gene flow—an extensive highland mass supporting steppe and both humid and arid pine-oak (Binford 1989, Fig. 1). A possible alternate corridor between the Oaxaca Valley and southern Puebla is afforded by the San Juan Bautista Cuicatlán valley, where *C. m. mexicanus* has been taken at the northern end at Teotitlán del Camino. Between the two valleys, finch habitat is separated by only a narrow stretch of arid pine-oak at about 2,100 m near San Francisco Telixtlahuaca (town at 1,728 m). Although this pathway is restricted by distance, narrowness of the elevational band suitable for arid subtropical scrub in the San Juan Bautista Cuicatlán valley, and the pine-oak barrier mentioned, it would seem the most likely of the two possibilities for gene flow. The available intergrade specimens, however, do not support this hypothesis. These are the two intermediates from Llano Verde and one from Rancho de las Rosas, taken in pine-oak well within the lower southern extent of the highlands separating the Oaxaca Valley from Huajuapán de León. However, the San Juan Bautista Cuicatlán valley has received little ornithological attention, and intergrades may occur there as well. More collecting is needed. Until then, we must assume that the known intergrades indicate at least minor gene flow directly through the highlands.

If global warming continues indefinitely, a significant number of House Finches might eventually breach the highland barrier, with the possible effect of *mexicanus*, with the larger population, swamping *roseipectus*. On the other hand, if any of the phenotypic characters of the Oaxaca Valley population are adaptive, it may retain its uniqueness, or be modified only in part. Moore (1939) correlated smaller size and the paler colour and narrower streaking of the abdomen with arid habitats. The Oaxaca Valley, positioned in a rain shadow caused by the encircling mountains, is drier than much of the range of *mexicanus* (Moore 1939; Binford 1989), so these three characters may indeed be adaptive.

### *C. m. griscomi*

I have given *C. m. griscomi*, an allopatric subspecies seemingly endemic to the Sierra Madre del Sur of Guerrero, only a cursory analysis. It appears to be rather weakly marked but justifiably recognizable because of its allopatry. The adult male (I did not examine females) is similar to *mexicanus* in lacking any reddish below the throat and in having wide dark streaks on the abdomen. It resembles *roseipectus* in its pale abdominal ground colour and pale flanks. Moore (1939) thought the upper parts “much paler gray” and the abdominal streaks wider than in *mexicanus*, but I see no difference in eight male specimens in the Louisiana State University Museum of Natural Science.



## Species limits

Moore (1939) and G. E. Hill (*in litt.*) have speculated that *mexicanus*, *roseipectus*, and *griscomi* form a group of populations specifically distinct from House Finches farther north, there being no known intergrades; Hill (1993a) stated that these three races are each other's closest relatives. My study sheds little light on this subject except to demonstrate that intergradation occurs between *roseipectus* and *mexicanus*, and therefore these two subspecies should be treated as belonging to the same group. I seriously doubt that isolating mechanisms exist between the two proposed species and predict that thorough collecting between the two will reveal intergradation.

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